

Meetings

Bone-Seeking Radionuclides

Radiation-induced cancer was the central theme of the international symposium on delayed effects of bone-seeking radionuclides, held 12 to 14 September 1967 at Sun Valley, Idaho. Six countries were represented in the 28 invited papers.

H. Spiess (University Children's Clinic, Göttingen, Germany) outlined his follow-up of about 1000 of some 2000 German patients injected with ^{224}Ra in the years 1944 to 1951. His was the first presentation of these studies to an English-speaking audience, and there was very keen interest. To date, 50 bone sarcomas have appeared, 35 of them in the 206 patients irradiated as children. For the bone sarcoma cases, the smallest total injected amount was about 400 microcuries of ^{224}Ra (in an 8-year-old child and also in a 70-year-old adult). When the dose-conversion factors of Maletskos are used, the radiation dose for the adult's skeleton was between 20 and 200 rad. Short-lived ^{224}Ra (3.6 days) appears considerably more toxic rad-for-rad than the long-lived ^{226}Ra (1600 years). The greater effectiveness of ^{224}Ra may be due to the fact that it decays quickly, before the apposition of new bone mineral can shield the living cells from α -irradiation.

A. J. Finkel (Argonne National Laboratory) reported 23 bone sarcomas and 16 neoplasms of the skull in 217 radium-containing persons. In all but one of these tumor cases, the residual amount of ^{226}Ra in the body exceeded $0.5\ \mu\text{C}$. In this one case, the amount of ^{226}Ra at tumor diagnosis (about 40 years after the start of exposure) was about $0.16\ \mu\text{C}$. This patient's peak content while dial painting was an estimated $1.2\ \mu\text{C}$.

R. D. Evans (Massachusetts Institute of Technology) summarized the studies at M.I.T. on persons exposed to ^{226}Ra and ^{228}Ra . There have been 28 bone sarcomas and 9 head carcinomas in the 90 persons whose skeletal dose exceeded 1200 rad. However, none of

these tumors has been observed in the 406 persons of this series whose doses were lower. A linear nonthreshold relation for the induction of these tumors seems extremely unlikely. Evans calculates that for a residual $1\ \mu\text{C}$ of ^{226}Ra in the body after 40 years, the cumulative radiation dose to the 7-kg skeleton of a standard man is about 2300 rad, and about 3200 rad to the 5-kg skeleton of a standard woman.

R. Mole (Harwell, England) assembled experimental data supporting his hypothesis that the radiation dose from a given radionuclide required to produce a given incidence of bone cancer is rather similar for a variety of mammals including man.

R. O. McClellan (Lovelace Foundation, Albuquerque, N.M.) presented an excellent and detailed review of the neoplasms induced by high doses of ^{90}Sr in experimental animals. When single high doses of ^{90}Sr are given to adult experimental animals, osteosarcomas frequently predominate. However, when repeated doses of ^{90}Sr are received early in life, the hematopoietic neoplasms may form a greater risk.

G. N. Taylor (University of Utah) reported that in beagles injected as adults, squamous-cell carcinomas in the head sinuses have been induced from ^{239}Pu , ^{226}Ra , and ^{90}Sr ; liver tumors from ^{239}Pu ; and eye melanomas from ^{228}Ra and ^{226}Ra . In all cases these tumors arose within heavily irradiated tissue. The induction of these soft-tissue tumors was much less frequent than the induction of osteosarcomas.

Y. I. Moskalev (Ministry of Public Health, Moscow) provided the concluding paper, which was read in English by C. Comar (Cornell University). For many in the audience, this was an introduction to Russian radiobiology. Experiments on the delayed effects of internally deposited radionuclides were reported for 5000 animals, mostly rats. Whereas no osteosarcomas were observed in 722 control rats or in 1365 rats injected with 0.005 to $2.5\ \mu\text{C}$ of ^{90}Sr per kilogram of body weight, osteosarcomas developed in 5 (7.4 per-

cent) of 68 rats given orally $0.5\ \mu\text{C}$ of ^{239}Pu daily from 3 months of age until death 370 days later. The average radiation dose to the bone was only 57 rad at death, and the inducing dose was likely much lower. Skeletally deposited ^{239}Pu is very effective in inducing bone cancer. Radiation protectionists throughout the world should take note of this finding.

Other senior authors were: D. Berliner, B. I. Bleaney, H. D. Bruner, L. K. Bustad, W. J. Clarke, T. Domanski, J. H. Dougherty, P. W. Durbin, M. P. Finkel, M. Goldman, W. S. S. Jee, C. J. Maletskos, L. D. Marinelli, J. H. Marshall, C. W. Mays, J. Müller, M. Rosenthal, F. W. Spiers, B. J. Stover, D. M. Taylor, and J. Vaughan.

This symposium was organized under the direction of T. F. Dougherty, head of the Radiobiology Division of the Anatomy Department at the University of Utah. It was supported by the U.S. Atomic Energy Commission. The proceedings, to be published by the University of Utah Press, should appear about October 1968.

CHARLES W. MAYS
Radiobiology Division, University of Utah, Salt Lake City, 84112

Calendar of Events

National Meetings September

9-13. American Fisheries Soc., 98th, Tucson, Ariz. (R. F. Hutton, 1040 Washington Bldg., Washington, D.C. 20005)

12-15. American Electroencephalographic Soc., San Francisco, Calif. (P. T. White, Marquette Univ. School of Medicine, 8700 W. Wisconsin Ave., Milwaukee, Wis. 53226)

12-17. Pacific Dermatologic Assoc., Coronado, Calif. (M. S. Falk, P.O. Box 1268, Reno, Nev. 89504)

13-15. Mid-Continent Psychiatric Assoc., Little Rock, Ark. (W. Young, 3504 Hill Road, Little Rock 72205)

15-21. Electron Microscope Soc. of America, 26th, New Orleans, La. (School of Chemical Engineering, Olin Hall, Cornell Univ., Ithaca, N. Y. 14850)

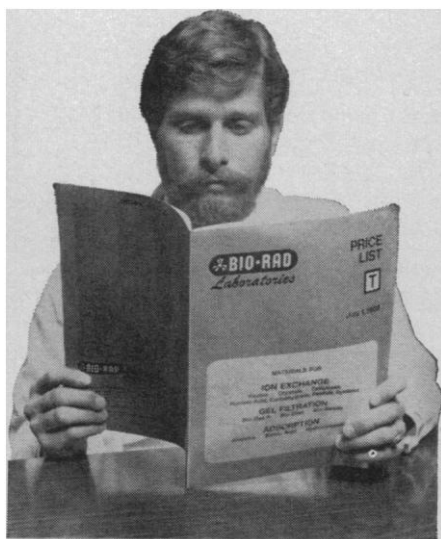
16-19. American Acad. of General Practice, Las Vegas, Nev. (M. F. Cahal, Volked Blvd. at Brookside, Kansas City, Mo. 64112)

18-20. Cancer, 6th natl. conf., Denver, Colo. (R. N. Grand, 219 E. 42 St., New York 10017)

19-22. American Medical Writers Assoc., Washington, D.C. (E. G. Dailey, P. O. Box 267, Arlington, Va. 22210)

22-25. American Fracture Assoc., Houston, Tex. (H. W. Wellmerling, 610 Griesheim Bldg., Bloomington, Ill. 61701)

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22-27. **Water Pollution Control Federation**, 41st, Chicago, Ill. (The Federation, 3900 Wisconsin Ave., NW, Washington, D.C. 20016)

23-25. **American Inst. of Aeronautics and Astronautics**, El Centro, Calif. (W. J. Brunke, 1290 Sixth Ave., New York 10019)

23-26. **Transplantation Soc.**, 2nd, New York. (F. T. Rapaport, New York Univ. Medical Center, 550 First Ave., New York 10016)

24-26. **American Soc. for Metals**, San Francisco, Calif. (American Soc. for Metals, Metals Park, Ohio 44073)

24-27. **American Soc. for Testing and Materials**, Cincinnati, Ohio. (T. A. Marshall, Jr., 1916 Race St., Philadelphia, Pa. 19103)

28-2. **Western Orthopaedic Assoc.** Colorado Springs, Colo. (V. Mathiesen, 354 21st Street, Oakland, Calif. 94612)

29-2. **American Soc. of Photogrammetry**, San Antonio, Tex. (E. C. Palmer, 105 North Virginia Ave., Falls Church, Va. 22046)

29-3. **Association of Medical Illustrators**, Chicago, Ill. (C. S. Holt, 738 Keystone Ave., River Forest, Ill. 60305)

30. **Society for Pediatric Radiology**, New Orleans, La. (J. L. Gwinn, Children's Hospital, 4614 Sunset Blvd., Los Angeles, Calif. 93027)

30-3. **American Psychiatric Assoc.**, 20th, Washington, D.C. (Public Information Office, 1700 18th St., NW, Washington, D.C. 20009)

30-3. **American Roentgen Ray Soc.**, Washington, D.C. (T. F. Leigh, Emory Univ. Clinic, Atlanta, Ga. 30322)

October

2-3. **Health Quackery**, 4th natl. congr., Chicago, Ill. (American Medical Assoc., Dept. of Investigation, 535 N. Dearborn St., Chicago 60610)

2-4. **Symposium on Materials for Radioisotope Heat Sources**, Gatlinburg, Tenn. (Chairman, Metallurgical Soc. of AIME, 345 E. 47 St., New York 10017)

3-4. **Fiber Soc.**, Washington, D.C. (L. Rebenfeld, Box 625, Princeton, N.J.)

3-5. **Canadian Soc. of Immunology**, Toronto, Ont., Canada. (H. Z. Movat, Dept. of Pathology, Univ. of Toronto, 100 College St., Toronto 2)

4. **Industrial Pharmaceutical Technology**, Philadelphia, Pa. (R. S. Joslin, William H. Rorer, Inc., Fort Washington, Pa. 19034)

4-5. **American Physical Soc.**, Hanover, N.H. (The Society, Executive Secretary, 528 W. 120 St., New York 10027)

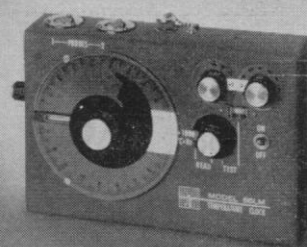
4-6. **National Conf. on Marine Sciences in Education**, Catalina Island, Calif. (R. B. Linsky, Coordinator, Marine Sciences and Director, Floating Lab Program, 1104 W. 8 St., Santa Ana, Calif. 92701)

4-8. **American College of Chest Physicians**, 10th, Washington, D.C. (M. Kornfield, 112 E. Chestnut St., Chicago, Ill. 60611)

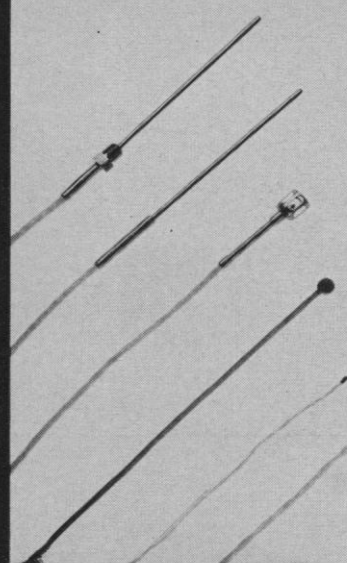
5-6. **National Congr. on Medical Ethics**, 2nd, Chicago, Ill. (Dept. of Medical Ethics, American Medical Assoc., 535 N. Dearborn St., Chicago 60610)

6-10. **Prestressed Concrete Inst.**, 14th Seattle, Wash. (R. J. Lyman, 205 W. Wacker Drive, Chicago, Ill. 60606)

7. **Industrial Pharmaceutical Technology**,



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7th mtg., Chicago, Ill. (J. Ellis, Abbott Labs., North Chicago, Ill. 60064)

7-10. **Thermal Conductivity**, 8th, Lafayette, Ind. (W. H. Shafer, Thermophysical Properties Research Center, 2595 Yeager Rd., West Lafayette, Ind. 47906)

7-11. **Activation Analysis** Conf., 3rd, Gaithersburg, Md. (National Bureau of Standards, Office of Technical Information and Publications, Room A500/101, Washington, D.C. 20234)

7-11. **Instrument Symp.** and Resarch Equipment Exhibit, 18th, Bethesda, Md. (J. B. Davis, National Institutes of Health, Bethesda 20014)

7-11. **Armed Forces Inst. of Pathology**, Washington, D.C. (Director, MEDEMPG, Armed Forces Inst. of Pathology, Washington, D.C. 20305)

8-10. Conference on **Analytical Chemistry in Nuclear Technology**, 12th, Gatlinburg, Tenn. (L. J. Brady, Oak Ridge Natl. Lab., P.O. Box X, Oak Ridge, Tenn. 37830)

8-13. **American Soc. of Clinical Hypnosis**, Chicago, Ill., (F. D. Nowlin, 800 Washington Ave., SE, Minneapolis, Minn. 55414)

9-11. **American Ceramic Soc.**, Bedford, Pa. (C. R. Kurkjian, Bell Telephone Labs., Murray Hill, N.J. 07974)

9-11. **Meteoritical Soc.**, 31st., Cambridge, Mass. (U. B. Marvin, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 02138)

9-11. **American Physical Soc.**, Athens, Ga. (L. W. Seagondollar, Dept. of Physics, North Carolina State Univ., Raleigh 27607)

9-12. **Optical Soc. of America**, Pittsburgh, Pa. (M. E. Warga, Optical Soc. of America, 2100 Pennsylvania Ave., NW, Washington, D.C. 20037)

10-11. Symposium on **Applications of Ferroelectrics**, Washington, D.C. (H. L. Stadler, Ford Motor Co., Dearborn, Mich.)

10-12. **American Thyroid Assoc.**, Washington, D.C. (W. McConahey, 200 First St., SW, Rochester, Minn. 55901)

11-13. Midwest Forum on **Allergy**, Chicago, Ill. (D. B. Frankel, 111 N. Wabash Ave., Chicago 60602)

11-13. **Philosophy of Science** Assoc., Pittsburgh, Pa. (G. J. Massey, Michigan State Univ., East Lansing)

11-18. **American Soc. of Clinical Pathologists**, New York, N.Y. (Administrative Secretary, 445 N. Lake Shore Dr., Chicago, Ill. 60611)

14-17. Association of **Official Analytical Chemists**, Washington, D.C. (L. G. Ensinger, P.O. Box 540, Benjamin Franklin Sta., Washington, D.C. 20014)

14-17. **Clay Minerals Soc.**, Bloomington, Ind. (J. B. Droste, Dept. of Geology, Indiana Univ., Bloomington 47401)

14-17. Conference on **Plasma Instabilities in Astrophysics**, Pacific Grove, Calif. (P. A. Sturrock, Inst. for Plasma Research, Via Crespi, Stanford Univ., Stanford, Calif. 94305)

14-17. **Metallurgical Soc.**, Detroit, Mich. (C. K. Carlson, American Inst. of Mining, Metallurgical and Petroleum Engineers, 345 E. 47 St., New York 10017)

14-18. **American Soc. of Civil Engineers**, Pittsburgh, Pa. (W. H. Wisely, American Soc. of Civil Engineers, 345 E. 47 St., New York 10017)

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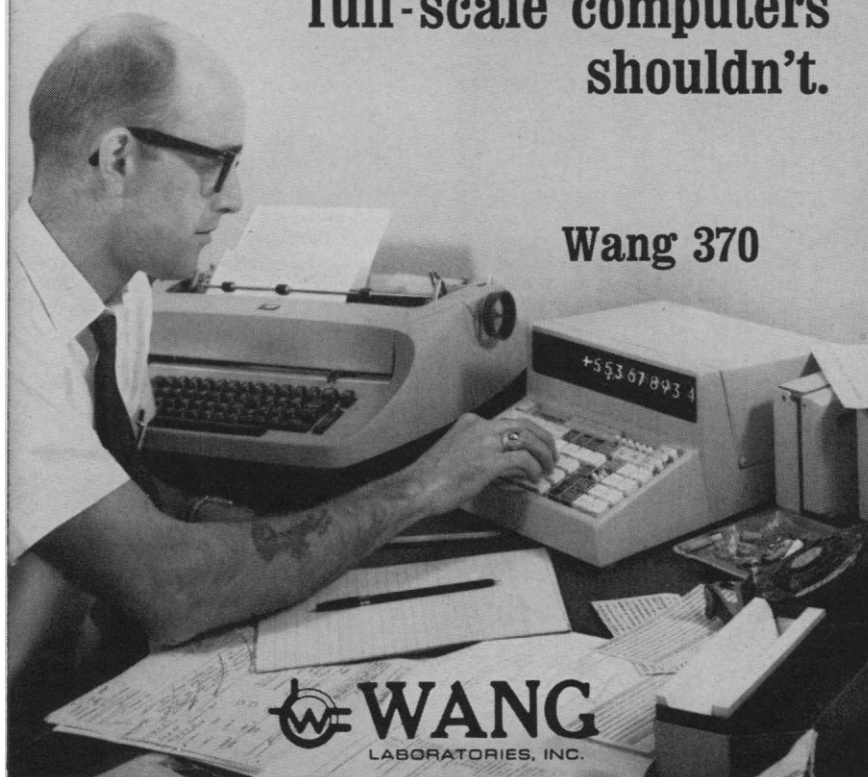
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15-16. **Industrial Hygiene Foundation**, 33rd, Pittsburgh, Pa. (R. T. P. deTreville, Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 15213)

15-18. **American Dietetic Assoc.**, 51st, San Francisco, Calif. (The Association, 620 N. Michigan Ave., Chicago, Ill., 60611)

17. **Animal Nutrition Research Council**, Washington, D.C. (L. Michaud, Merck Sharp & Dohme Research Labs., Rahway, N.J. 07065)

17-18. **National Fluid Power Assoc.**, Chicago, Ill. (W. R. Smith, 3300 S. Federal St., Chicago 60616)

17-19. **California Assoc. of Criminalists**, 32nd semiannual, Lake Tahoe. (The Association, Box 2172, Redwood City, Calif. 94064)

17-19. **Central Neuropsychiatric Assoc.**, Oklahoma City, Okla. (C. S. Hoekstra, 8215 Westchester Dr., Dallas, Tex. 75225)

17-19. **American Assoc. for the Surgery of Trauma**, Montreal, P.O., Canada. (S. R. Gaston, 180 Fort Washington Ave., New York, N.Y.)

19-23. **American Soc. of Anesthesiologists Inc.**, Washington, D.C. (Assistant Executive Secretary, 515 Busse Highway, Park Ridge, Ill.)

19-24. **American Acad. of Pediatrics**, Chicago, Ill. (The Academy, Dept. of Public Information, 1801 Hinman Ave., Evanston, Ill. 60204)

20-21. **American Assoc. of Poison Control Centers**, 11th, Chicago, Ill. (C. A. Walton, Drug Information Center, Univ. of Kentucky Medical Center, 800 Rose St., Lexington)

20-24. **American Soc for Information Science**, 31st., Columbus, Ohio. (J. B. Fox, Chemical Abstracts Service, Ohio State Univ., Columbus 43210)

21-23. **Interscience Conf. on Antimicrobial Agents and Chemotherapy**, 8th, New York, N.Y. (American Soc. for Microbiology, 115 Huron View Blvd., Ann Arbor, Mich. 48103)

21-23. **Solar Energy Soc.**, Palo Alto, Calif. (The Society, Arizona State Univ., Tempe 85281)

21-24. **Society for Industrial and Applied Mathematics**, Philadelphia, Pa. (B. R. Agins, Courant Inst. of Mathematical Sciences, New York Univ., 251 Mercer St., New York 10012)

21-25. **American Assoc. for Lab. Animal Science**, 19th, Las Vegas, Nev. (J. J. Garvey, Box 10, Joliet, Ill. 60434)

22-24. **Shock and Vibration Symp.**, Monterey, Calif. (W. W. Mutch, Code 6020, Shock and Vibration Information Center, Naval Research Lab., Washington, D.C. 20390)

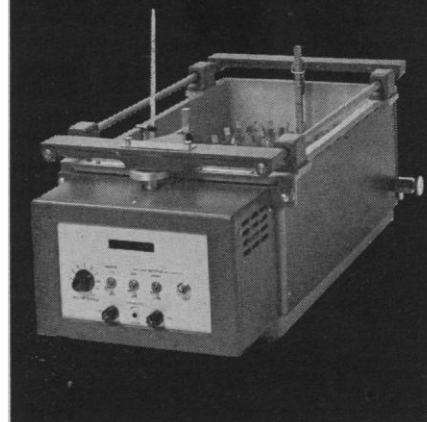
23. **American Oil Chemists Soc.**, New York, N.Y. (C. H. Hauber, The Society, 35 E. Wacker Dr., Chicago, Ill. 60601)

23-24. **Helium Applications Symp.**, Washington, D.C. (L. A. Gutkind, 725 Liberty, Pittsburgh, Pa. 15222)

23-25. **American Ceramic Soc.**, Pasadena, Calif. (H. L. Hedrick, Southern Counties Gas Co., 720 W. 8 St., Los Angeles, Calif. 90017)

23-25. **IEEE Nuclear Science Symp.**, Montreal, Canada. (O. L. Tiffany, Bendix

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24-25. Metropolitan Engineers Council on Air Resources, New York, N.Y. (R. A. Fox, P.O. Box 270 Mount Vernon, N.Y. 10550)

24-26. Association for Research in Ophthalmology, Chicago, Ill. (Dept of Ophthalmology, Univ. of Florida College of Medicine, Gainesville 32601)

24-26. Society for the Scientific Study of Religion, Montreal, P.Q., Canada. (S. Z. Klausner, 3800 Locust St., Philadelphia, Pa. 19104)

25-26. Orton Soc., Inc., New York N.Y. (M. B. Rawson, Orton Soc., Inc., Box 153, Pomfret, Conn. 06258)

26-27. American College of Dentists, Miami Beach, Fla. (O. W. Brandhorst, 4236 Lindell Blvd., St. Louis, Mo., 63108)

26-27. Southern Electroencephalographic Soc., Birmingham, Ala. (G. S. Ferriss, 1542 Tulane Ave., New Orleans, La. 70112)

27-30. Computer Aided Circuit Design and Analysis, St. Charles, Ill. (Natl. Electronics Conf., Inc., Oakbrook Executive Plaza No. 2, 1211 W. 22 St., Oak Brook, Ill. 60521)

27-1. American Acad. of Ophthalmology and Otolaryngology, Chicago, Ill. (W. L. Benedict, 15 Second St., SW, Rochester, Minn. 55901)

27-1. American Soc. of Plastic and Reconstructive Surgeons, New Orleans, La. (P. P. Pickering, 2850 Sixth Ave., Suite B, San Diego, Calif. 92103)

28-29. Conference on Evaluation of Safety of Cosmetics, Washington, D.C. (AMA Committee on Cutaneous Health and Cosmetics, 535 N. Dearborn St., Chicago, Ill. 60610)

28-29. International Conf. on Materials, Pittsburgh, Pa. (R. B. Barnhart, Conf. Manager, Warner Hall 111, Carnegie-Mellon Univ., Pittsburgh)

28-30. Hybrid Microelectronics Symp., Chicago, Ill. (J. English, Cozzens and Cudahy, 9501 W. Devon Ave., Rosemont, Ill. 60018)

28-31. American Assoc. of Blood Banks, Washington, D.C. (L. J. James, 30 N. Michigan Ave., Chicago, Ill. 60602)

28-31. Instrument Soc. of America, New York, N.Y. (H. S. Kindler, The Society, 530 William Penn Pl., Pittsburgh, Pa. 15219)

28-1. Society for Experimental Stress Analysis, San Francisco, Calif. (The Society, 21 Bridge Sq., Westport, Conn. 06880)

29-31. Conference and Workshop on Applied Climatology, Asheville, N.C. (H. T. Harrison, Route 1, Box 266, Weather-ville, N.C. 28787)

31-1. Educational Conf., 33rd, New York, N. Y. (W. S. Litterick, Educational Records Bureau, 21 Audubon Ave., New York 10032)

31-1. Entomological Soc. of America, 40th, Philadelphia, Pa. (J. P. Johnson, Connecticut Agricultural Experiment Sta., Box 1106, New Haven 06504)

31-2. Gerontological Soc., Denver, Colo. (The Society, 660 S. Euclid, St. Louis, Mo. 63110)

31-1. American Soc. for Microbiology, 8th, New York, N.Y. (R. W. Sarber, 115

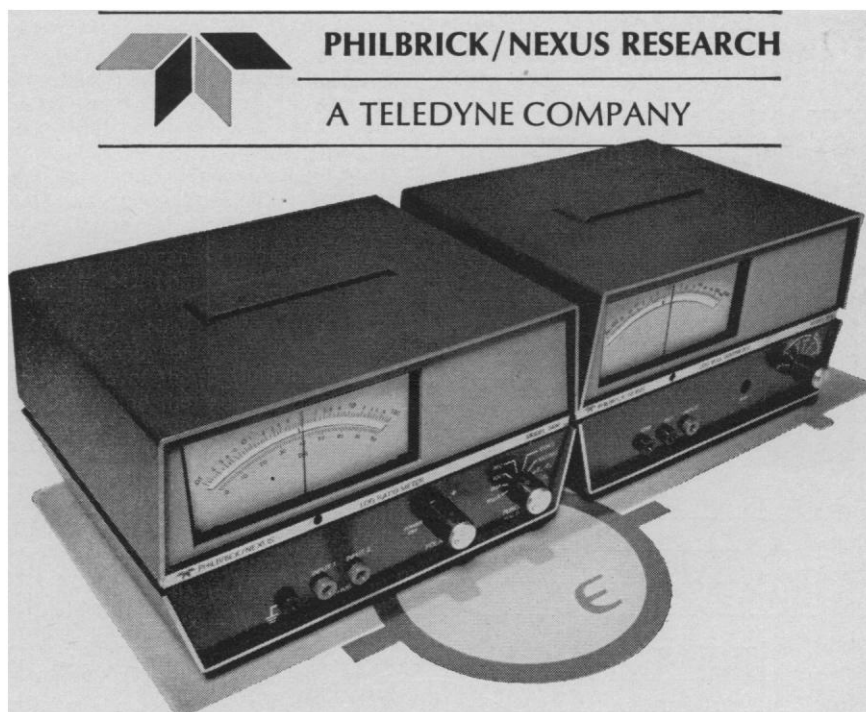
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Huron View Blvd., Ann Arbor, Mich.)
31-1. Symposium on **Social Behavior**, 2nd, Oxford, Ohio. (R. A. Hoppe, Dept. of Psychology, Miami Univ., Oxford 45056)

31-1. American Soc. of **Tropical Medicine and Hygiene**, Atlanta, Ga. (G. M. Jeffery, P.O. Box 295, Kensington, Md.)

31-2. Society of **Photographic Scientists and Engineers**, Washington, D.C. (R. A. Jones, Papers Chairman, Mail Sta. 68, Perkin-Elmer Corp., Norwalk, Conn. 06852)

International and Foreign Meetings

September

22-28. International Congr. of **History of Medicine**, 21st, Siena, Italy. (Professor Stroppiana, Kiale Universita, 34/A Rome)

23-25. International Congr. of **Psychodrama and Sociodrama**, 3rd, Prague, Czechoslovakia. (J. L. Moreno, 259 Wolcott Ave., Beacon, N.Y. 12508)

23-26. Institute of **Physics and the Physical Soc.**, Culham, Abingdon, England. (Meetings Officer, 47 Belgrave Sq., London, S.W.1)

23-27. International Soc. of **Cybernetic Medicine**, 5th, Naples, Italy. (P. Battarra, S.I.M.C., 348 Via Roma, Naples)

23-28. South African Intern. **Ophthalmological Symp.**, 1st, Johannesburg, S. Africa. (Dept. of Ophthalmology, Medical School Hospital, Johannesburg)

24-26. **Power Sources Symp.**, 6th, Brighton, England. (D. H. Collins, Joint Services Electrical Power Sources Committee, POB 136, 26 Wellesley Rd., Croydon, Surrey)

24-28. Congress of **Neurological Surgeons**, Toronto, Ont., Canada. (J. M. Thompson, 1955 Blossom Way South, St. Petersburg, Fla. 33712)

24-28. Symposium on **Technical and Biological Problems of Control**, Erivan, U.S.S.R. (A. S. Iberall, General Technical Services, 8794 W. Chester Pike, Upper Darby, Pa. 19082)

25-30. International Union of the **History and Philosophy of Science**, 12th, Paris, France. (R. Taton, 3, rue Gay Lussac, Paris 5E)

26-28. International Congr. of **Sociometry and Social Psychology**, 1st, Prague, Czechoslovakia. (J. L. Moreno, 259 Wolcott Ave., Beacon, N.Y. 12508)

30-3. European Congr. of **Allergology**, Berlin, Germany. (H. Herxheimer, Rudolph Virchow Krankenhaus, Augustengurgen Platz 1, Berlin 65)

30-5. **Physicists Conf.**, Karlsruhe, Germany. (H. Schopper, POB 947, 75 Karlsruhe)

October

4-11. International College of **Surgeons**, 16th, Tokyo, Japan. (Secretary General, 1516 Lake Shore Dr., Chicago, Ill. 60610)

6-10. **Electrochemical Soc.**, 134th, Tokyo, Japan. (c/o Japan Cement Engineering Assoc., No. 1, Akasaka-Daimachi, Minato-Ku, Tokyo)

7-9. International **Gel Permeation Chromatography Seminar**, 6th, Miami Beach, Fla. (Chairman, The Seminar, c/o Waters Associates, Inc., 61 Fountain St., Framingham, Mass. 01701)

7-11. International Federation for Preventive **Medicine and Hygiene**, 5th, Rome, Italy. (Via Filippo Civinni 37, Rome)

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